

5 Field of the invention

The present invention relates to improvements in the process of recovering hydrocarbons in oil wells by injection of treated inert gases obtained from industrial effluence.
10 Particularly it refers to a process of recovering hydrocarbons in oil wells by injection of treated inert gases obtained from the process of cement clinker production.

Preceding of the invention

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Fossil fuels have successfully been burned in furnaces for a long time. Nevertheless, the possible reduction or minimization of air contamination is more and more being emphasized recently. In this aspect it is known that there is
20 environmental contamination due to toxic substances. Environmental contamination also arises from substances or materials that contribute to the global warming, such as CO₂ for example.

25 Oil well production is classified in free-flowing and artificial production. With the first, hydrocarbons gush to the outside by natural energy, which can be hydraulic pressure or the inherent gas pressure of the deposit. Artificial oil well production or oil well production by pumping is an
30 exploitation system applied, if the inherent pressure of the deposit is not sufficient for the oil to flow up to the surface.

35 In the past, oil wells, which were not flowing by inherent energy, were abandoned, thus generally recovering 20% of the total reserves. With the perfection of the exploitation

these oil deposits was increased. Actually, if an oil well stops flowing, artificial exploiting methods are applied such as pneumatic, mechanical or hydraulic pumping.

5 Additionally, there exist systems, which improve the recovery by the injection of natural gas, nitrogen, carbon dioxide or water into the deposit. These systems proved to considerably increase the recovery of hydrocarbons at the deposits, making said recovering process more efficient, additionally
10 increasing the production capacity of the deposits and allowing a reasonable exploitation of the oil resources. On the other hand, the costs for production and preparation of said gases are rather considerable.

15 Prior Art and cross reference to related applications

Hydrocarbon recovery by injection of inert gases is already known for exhausted oil wells. The following patents show endeavors for its realization and as a reference their
20 specifications are incorporated.

U.S.patent 3,873,238 with the tittle "Method and apparatus for flowing crude oil from a well" of Johnnie A. Elfarr, granted on March 25th, 1975 relates to a method and apparatus for
25 flowing crude oil from wells wherein a fluid is injected into the oil bearing earth formation for the purpose of reducing the viscosity of the oil and causing it to migrate under induced formation pressure to one or more production wells.

30 U.S.patent 3,892,270 with the title "Production of hydrocarbons from underground formations" of Robert H. Lindquist, granted on July 1st, 1976 relates to a method for recovering hydrocarbons by injecting a mixture of oxidizing gas and steam into a lateral conduit of a hydrocarbon-
35 containing formation to produce a product gas and, based on values contained in such gas, controlling the reactions

in the formation to optimize the Kilocalories value (BTU) of the product gas.

5 In U.S.patent 4,267,885 with the title "Method and apparatus for optimizing production in a continuous or intermittent gas-lift well" of Dorsey W. Sanderford, granted on May 1st, 1981 the temperature of the fluid is sensed at the wellhead and used to determine the injection parameter values to optimize well production. In one embodiment, a process control unit is
10 programmed according to the inventive method to interpret the temperature data and to control the gas control valve in order to optimize production.

15 U.S.patent 4,025,235 with the title "System for improving oil well production" of Joseph S. Newbrough, granted on May 24th, 1977 relates to a system utilizing intermittent build-up and release of gas pressure in the annulus between the casing and tubing in an oil well with an inert gas interface between the gas and the producing fluid.

20 U.S.patent 4,480,697 with the title "Method and apparatus for converting an oil well to a well with effluent raising by gas lift" of Rene F. Goldaniga, Geard Walter, G. W. Walter, Bernard J. P. Glotin and Daniel Gallois, granted on November
25 6th, 1984 relates to a method of and apparatus for converting an oil well with natural effluent rise to one with gas-lift of the effluent column, wherein the oil well has a nipple in the production tube provided with a stop-groove and smooth bearing surfaces between which a hydraulic control line comes out.

30 U.S.patent 4,649,994 with the title "Installation for bringing hydrocarbon deposits into production with reinjection of effluents into the deposit or into the well or wells" of Gerard Chaudot, granted on March 17th, 1987 relates to an
35 installation for bringing into production hydrocarbon deposits with reinjection of effluents into the deposit or into the

installation comprises at least one sealed casing, the base of which communicates with the deposit; at least one sealing plug disposed in the lower part of the casing and forming a capacity; at least one duct for either injecting or removing a pressurized gas; a condensate injection pipe passing through the capacity and opening into the base of the casing beyond said plug, this pipe communicating with the inner volume of the casing downstream of the plug, as well as with said capacity through a valve system.

U.S.patent 5,105,889 with the title "Method of production of formation fluid and device for effecting thereof" of Taimuraz K. Misikov, Vladimir M. Shaposhnikov and Alexandr P.Skripkin granted on April 21th, 1992 relates to a method of production of the formation fluid, which is used in wells with a low formation pressure. The method consists in that the gas is dissolved in the well from a flow of the formation fluid forcedly liberated, whereupon the formation fluid is transformed into a finely dispersed gas-liquid flow in which the amount of liberated gas ensures self-lift of the formation fluid to the wellhead.

WO98/0233A2 with the title "Fluid separation and reinjection systems for oil wells" of Christopher K.Shaw published on November 7th, 1997 relates to a fluid separation and reinjection system for use in a wellbore extending through a production zone producing an oil/water mixture and a water reinjection zone, which comprises a tubing disposed within the wellbore in fluid communication with the production zone defining an oil flow channel and in fluid communication with the water reinjection zone defining a water reinjection channel.

Neither the references cited above nor the literature to the best knowledge of the inventors reveal the possibility of

from the burning of clinker for the recovery of hydrocarbons from exhausted oil wells.

Summary of the invention

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An object of the present invention is to recover hydrocarbons from exhausted oil wells by treated inert gases, which arise from the effluence (escape or chimney gases) of industrial waste. The inert gases are mostly composed of nitrogen and

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carbon dioxide.

Another object of the present invention is to utilize the emission gases of the combustion and calcination in production processes, in particular in the processes of the cement

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clinker production.

Another object of the present invention is to utilize emission gases of the combustion of materials such as fossil fuel (oil, gas and coal) or alternative fuels such as waste tires and

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waste wood, etc.

Another object of the invention is the reduction of the contamination level of cement clinker production processes.

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The invention has as additional object the treatment of combustion gases in order to utilize them in other processes in which certain of their components are used.

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Another object of the invention is to reduce contamination of cement clinker production.

Description

The present invention relates to improvements in the process of recovering hydrocarbons in oil wells. The recovering of hydrocarbons is realized by the injection of treated inert

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gases of one or various industrial effluences. Actually, the improvements of the process consist in

- 5 - treating the industrial effluence by operations appropriate to make constituents and parameters such as for example temperature, concentration, pressure and/or expenditure of the industrial effluence compatible with the hydrocarbons of the deposit and
- 10 - regulating the distribution of different types of gases from their place of origin.

In one embodiment of the invention the industrial effluences were selected from combustion and/or calcination gases from production processes.

- 15 Some examples for the operations used for the invention are adsorption, separation of dust, condensation, liquefaction and distillation, compression and distribution. These operations, which are known in detail to those who are skilled in the art, are not described in the present specification for reasons of
- 20 simplicity.

- 25 The inert gases according to the invention comprise a mixture of N_2 and CO_2 with a percentage of 75 to 85 and 15 to 25%, such that the sum results in 100%.

- 30 It has been found that in order to make the constituents compatible it is particularly advantageous to augment the concentration of N_2 in the injection gases taking a part of the air coming from the chimney.

By the present invention it is possible to recycle water and oxygen.

- 35 Surprisingly it was found that by the present invention the production of the cement clinker production was reduced.

Short description of the drawings

A number of objects of the invention have been mentioned above. Other objects and advantages of the invention will appear according to the progress of the invention by taking into account the following drawings, in which an example of the best way of the invention is illustrated. Taking into account the figures of the drawings

Fig.1 is a schematic diagram of the process according to the present invention, which includes both the cement process and the process of the oil deposit and

Fig.2 is a schematic diagram of the conditioning of the combustion gases in the cement process for the injection into the oil deposit.

Detailed description of the drawings

With reference to the figures a first embodiment is shown in Fig.1 and Fig.2. The invention follows the part of the cement process, where as raw materials limestone and clay are fed (10) to a step of crushing and prehomogenization (20) whereupon follows a step of grinding the raw material (30). The ground raw material is supplied to a kiln system (40), wherefrom it is proceeded on the one hand to cement grinding (50) and thereupon to storage and distribution of the cement (60). On the other hand low-pressure CO_2 and N_2 (110) as effluence pass through a compressor (115) in order to produce high-pressure CO_2 and N_2 (120) for supplying them to the oil deposit, in which the gas phases (130), oil (140) and water (150) are found.

As is illustrated in Fig.2 the conditioning of the gases in the cement process comprises in a particular embodiment a step of additional dust removal, a

step of liquefaction and distillation with CO₂ and O₂, which can be recycled and a final step of compression and distribution of N₂ and CO₂. This structure or configuration is preferred for the present application but may not be necessary for other applications.

Description of an example including the best mode of the invention

The demand for inert gases for recovering hydrocarbons in the oil deposits in the region of the south of Mexico is approximately 16 million m³/day (564 million cubic feet/day). This volume being required a net of distribution ducts is envisaged from various potential sources in order to inject gases into the oil deposits considering the gas-producing sources near the oil deposits having supplying potential. The potential sources are shown in table 1.

Table 1: Potential sources of gas injection into oil deposit in the Southeast region.

Sources	Inert gas	Ntcfd	Ncmd	%
Apasco, Mucspana	CO ₂ , N ₂	148 344	4 200 000	26
Campo Carmito	CO ₂	80 000	2 264 000	14
Petroquimicas	CO ₂	100 000	2 830 000	18
Apasco, Orizaba	CO ₂ N ₂	235 656	6 669 065	42
Total potential		564 000	15 961 200	100

Ntcfd: Normalized (0°C, 1 atm) thousand cubic feet per day;

Ncmd: Normalized (0°C, 1 atm) cubic meter per day

The table shown above indicates the total distribution of the injection gases required for all oil deposits in the Southeast

oil exploiting region with the supply of a number of near sources producing inert gases.

5 It should be evident, that the requirements of the inert gases will vary from one oil deposit to another, the parameters like pressure and temperature of the gas supply will have to be considered and that the distribution of the producing sources of different types of gases will be a function of the compatibility of these gases with the hydrocarbons of the
10 deposit.

A number of details of the invention can be changed without going beyond the scope of the invention. Additionally, the above description of the preferred embodiment of the invention
15 and the best way for carrying out the invention is proposed merely for the intention of illustration and not for the intention of limitation. The invention is defined only by its claims.